

1. Apparatus for depositing and enhancing a nitride film on a semiconductor wafer comprising:
 - a process chamber;
 - a showerhead positioned within the process chamber;
 - 5 a gas source connected to the showerhead for supplying a metallo-organic precursor and a plasma annealing gas;
 - a wafer support positioned within the process chamber;
 - a heater positioned proximate the wafer support, wherein the heater supplies sufficient energy to the
 - 10 metallo-organic precursor to decompose the metallo-organic precursor and deposit a nitride film; and
 - at least one RF source coupled to the showerhead and the wafer support, wherein the at least one RF source couples RF energy to the showerhead and the wafer support
 - 15 to produce an annealing plasma that improves resistivity of the nitride film.
2. The apparatus of claim 1, wherein the annealing gas comprises at least one of nitrogen and hydrogen.
- 20 3. The apparatus of claim 2, wherein the decomposition of the metallo-organic precursor deposits a film of titanium nitride upon a semiconductor wafer.
- 25 4. The apparatus of claim 2, wherein the depositing and annealing of the nitride film are both performed within the processing chamber.
5. The apparatus of claim 2, wherein the plasma annealing
- 30 gas comprises at least one of nitrogen, hydrogen, helium, and argon.
6. The apparatus of claim 2, wherein the plasma annealing gas comprises nitrogen and hydrogen having a nitrogen to
- 35 hydrogen ratio between about 3:1 and about 1:2.

7. The apparatus of claim 1, wherein the at least one RF source further comprises:

- a first RF source coupled to the showerhead; and
- 5 a second RF source coupled to the wafer support.

8. The apparatus of claim 7, wherein the first RF source controls the plasma annealing and the second RF source provides a bias voltage on the semiconductor wafer.

10

9. The apparatus of claim 7, wherein the first RF source produces a first RF signal and the second RF source produces a second RF signal, and wherein the first and second RF signals are 180 degrees out of phase.

15

10. The apparatus of claim 1, wherein the metallo-organic precursor is tetrakis(dimethylamido) titanium (TDMAT).

11. The apparatus of claim 1, wherein the gas source
20 supplies nitrogen

12. The apparatus of claim 11, wherein the decomposed metallo-organic precursor provides a metal that combines with the nitrogen to deposit a nitride film.

25

13. The apparatus of claim 1, wherein the wafer support is maintained at a temperature of between about 350 to about 450 degrees Celsius.

30 14. The apparatus of claim 1, wherein the heater is operable in the absence of a plasma.

15. The apparatus of claim 1, wherein the heater is operable with a plasma.

35

16. Apparatus for depositing and enhancing a nitride film on a semiconductor wafer comprising:

a process chamber;

a showerhead positioned within the process chamber;

5 a gas source connected to the showerhead for supplying a deposition gas mixture comprising tetrakis(dimethylamido) titanium (TDMAT) and nitrogen and supplying an annealing gas comprising at least one of hydrogen, nitrogen, helium, and argon;

10 a wafer support positioned within the process chamber;

a heater positioned proximate the wafer support, wherein the heater supplies sufficient energy to the TDMAT to decompose the TDMAT and deposit a film of titanium nitride on the semiconductor wafer;

15 a first RF source coupled to the showerhead to control an annealing plasma using the annealing gas that improves resistivity of the titanium nitride film; and

a second RF source coupled to the wafer support to control bias of the semiconductor wafer while exposing the
20 titanium nitride film to the annealing plasma.

17. The apparatus of claim 16, wherein the first RF source produces a first RF signal and the second RF source produces a second RF signal, and wherein the first and
25 second RF signals are 180 degrees out of phase.

18. The apparatus of claim 16, wherein the wafer support is maintained at a temperature of between about 350 to about 450 degrees Celsius.

30

19. The apparatus of claim 16, wherein the depositing and annealing of the titanium nitride film are both performed within the processing chamber.

20. The apparatus of claim 16, wherein the annealing gas is hydrogen, and wherein the ratio of nitrogen to hydrogen is between about 3:1 and about 1:2.

5 21. The apparatus of claim 16, wherein the heater is operable in the absence of a plasma.

22. The apparatus of claim 16, wherein the heater is operable with a plasma.